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Ishii

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(54) **LINE-SHAPED MATERIAL CONVEYANCE MECHANISM, LINE-SHAPED MATERIAL CONVEYANCE METHOD, AND TAPE CONVEYANCE MECHANISM**

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G11B 15/43	(2006.01)
G11B 15/66	(2006.01)
G11B 15/665	(2006.01)
B25J 9/04	(2006.01)

(52) **U.S. Cl.**

CPC ***G11B 15/43*** (2013.01); ***G11B 15/66*** (2013.01); ***G11B 15/6651*** (2013.01); ***G11B 15/672*** (2013.01); *B25J 9/04* (2013.01)

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CPC G11B 15/06; G11B 15/65; G11B 15/6651; G11B 15/6653; G11B 15/67; G11B 15/672; B25J 9/04; B25J 9/047

USPC 360/95, 93; 242/332, 332.4; 74/490.01, 74/490.03, 490.05

See application file for complete search history.

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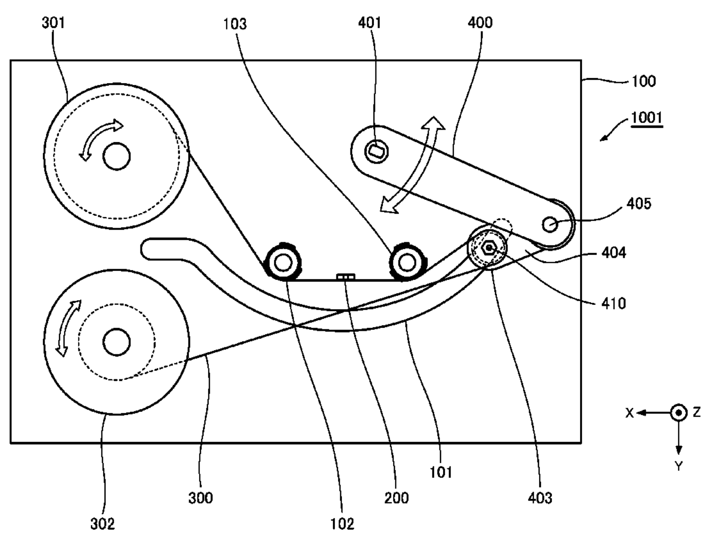
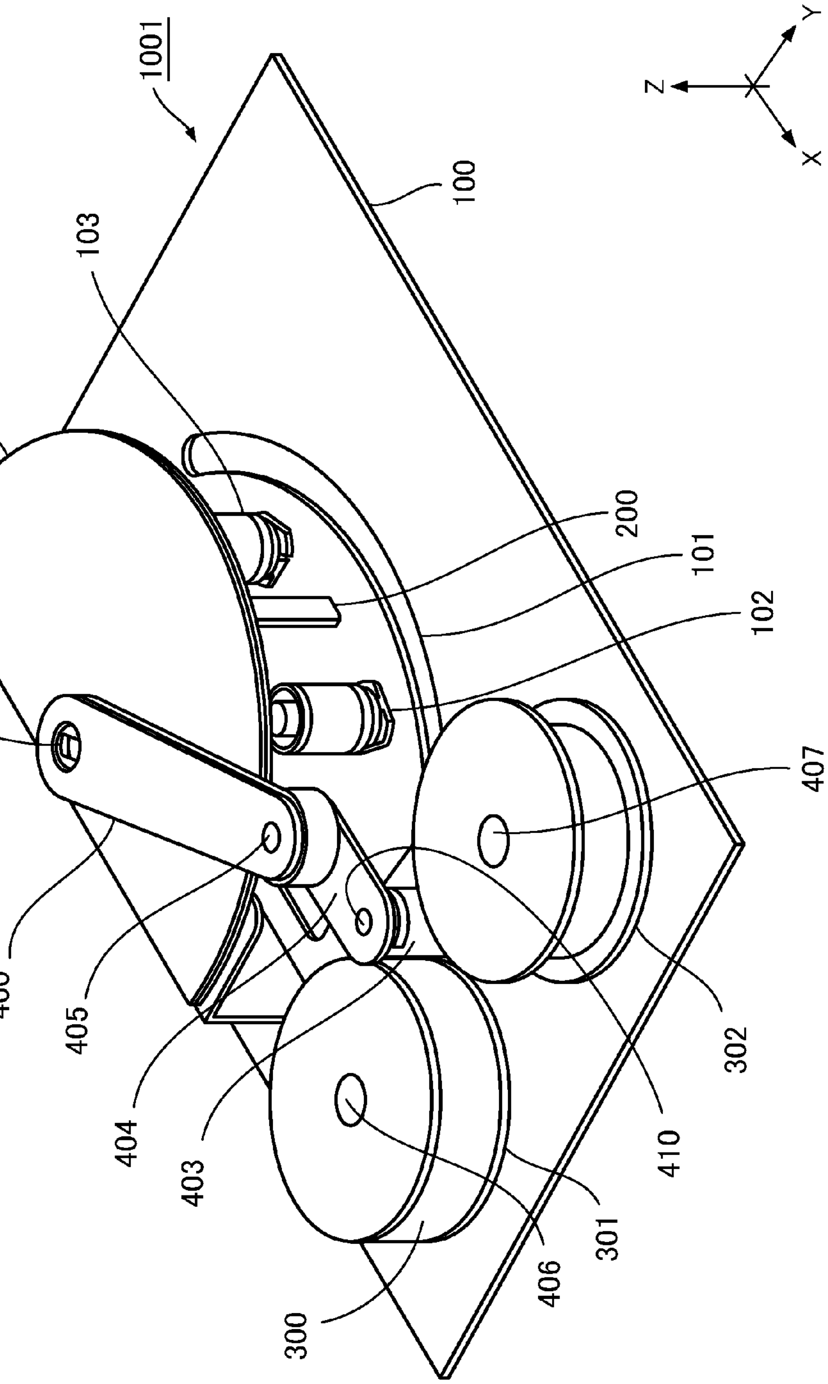
(57) **ABSTRACT**

A line-shaped material conveyance mechanism includes first and second support members, a guide groove, a first rotary arm, and a second rotary arm. One end of the first rotary arm is pivotally supported near the guide groove by a first rotary shaft. The other end of the first rotary arm connects one end of the second rotary arm in a state that can be rotated. A third support member is disposed on the other end of the second rotary arm. The third support member is guided and moves along the guide groove by rotating the first rotary arm around the first rotary shaft.

9 Claims, 6 Drawing Sheets




1001
Z
Y
X
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200
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401
407
400
405
302
404
403
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301
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300

Fig. 1

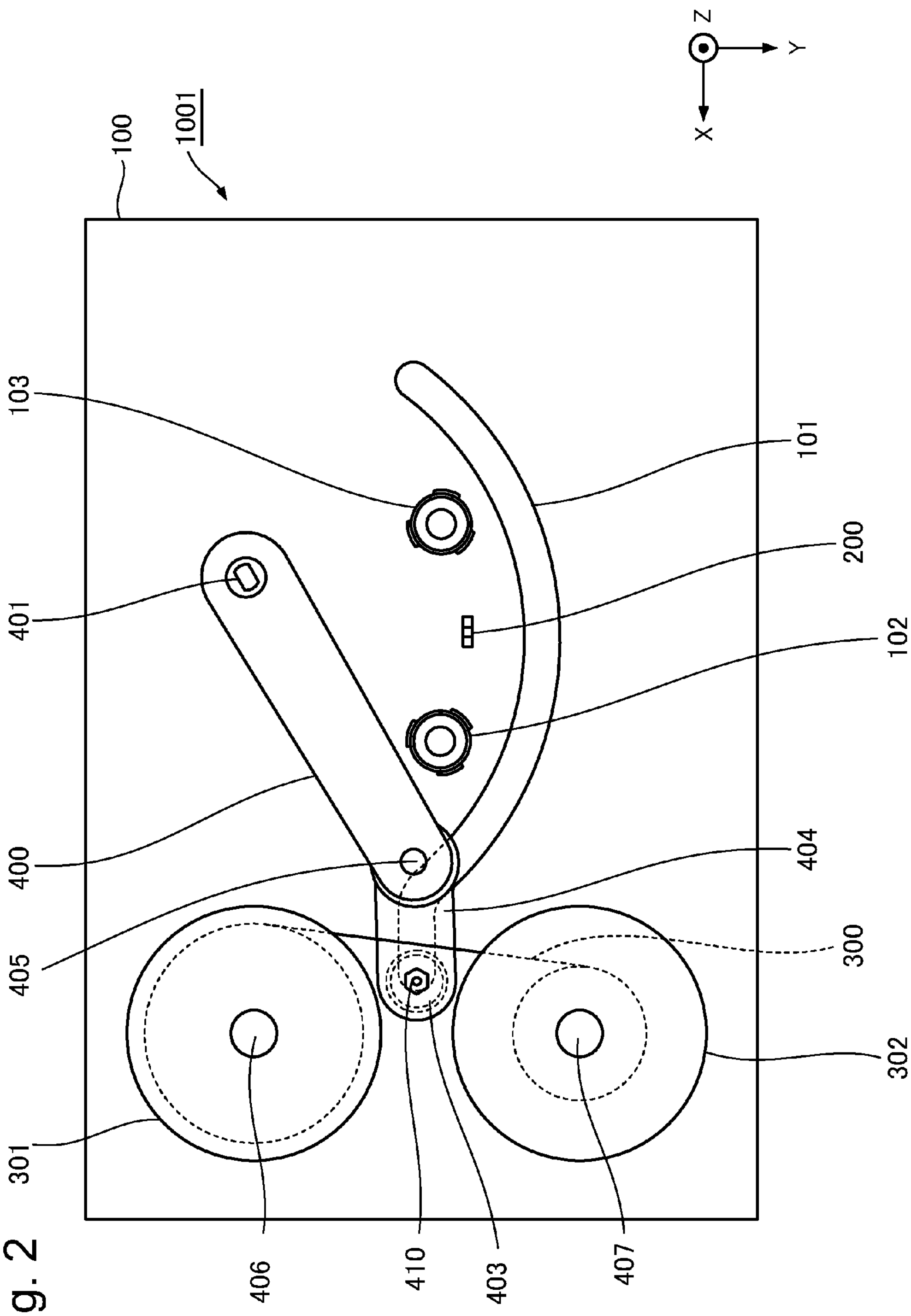
Z
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Fig. 2

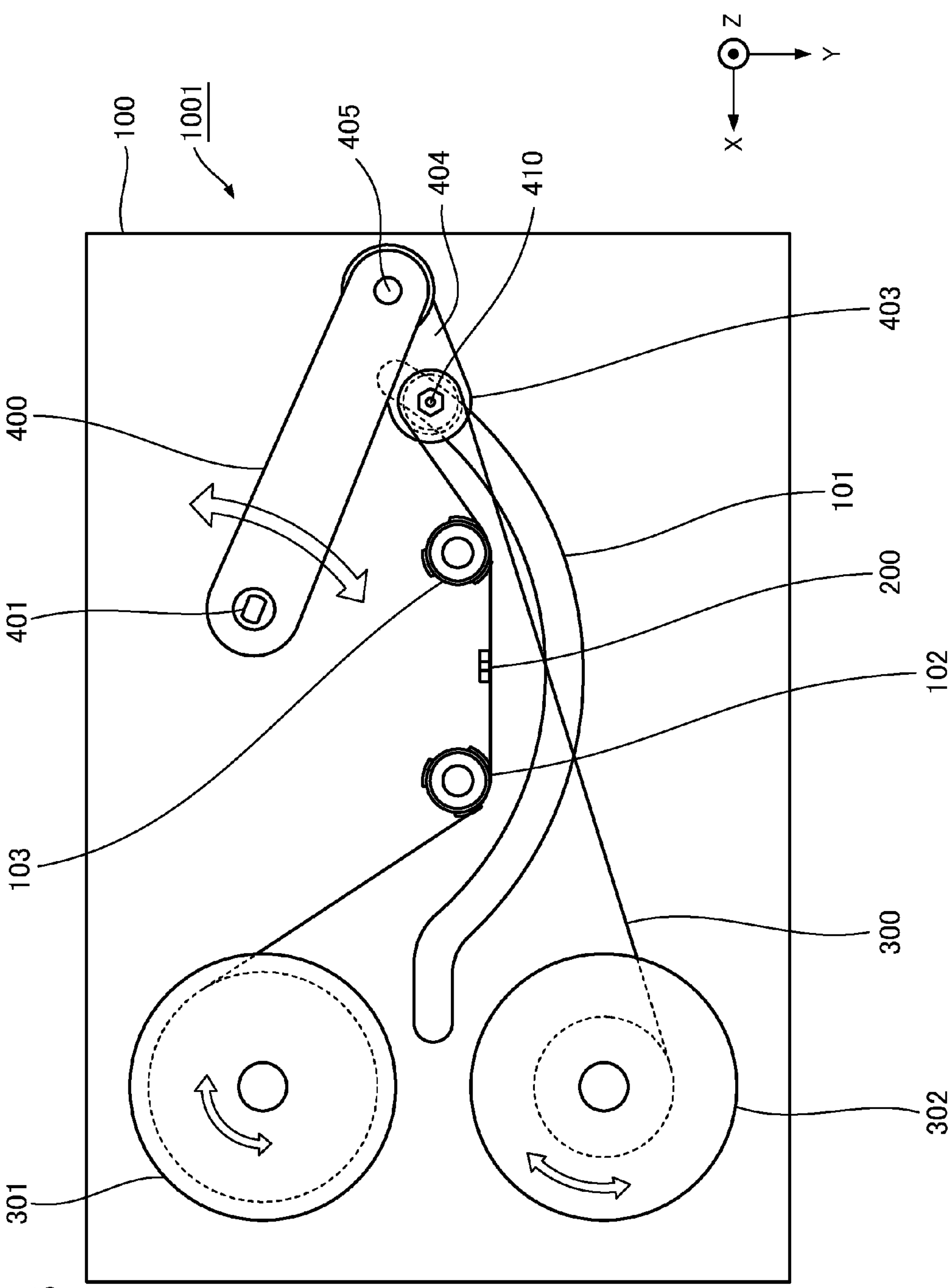
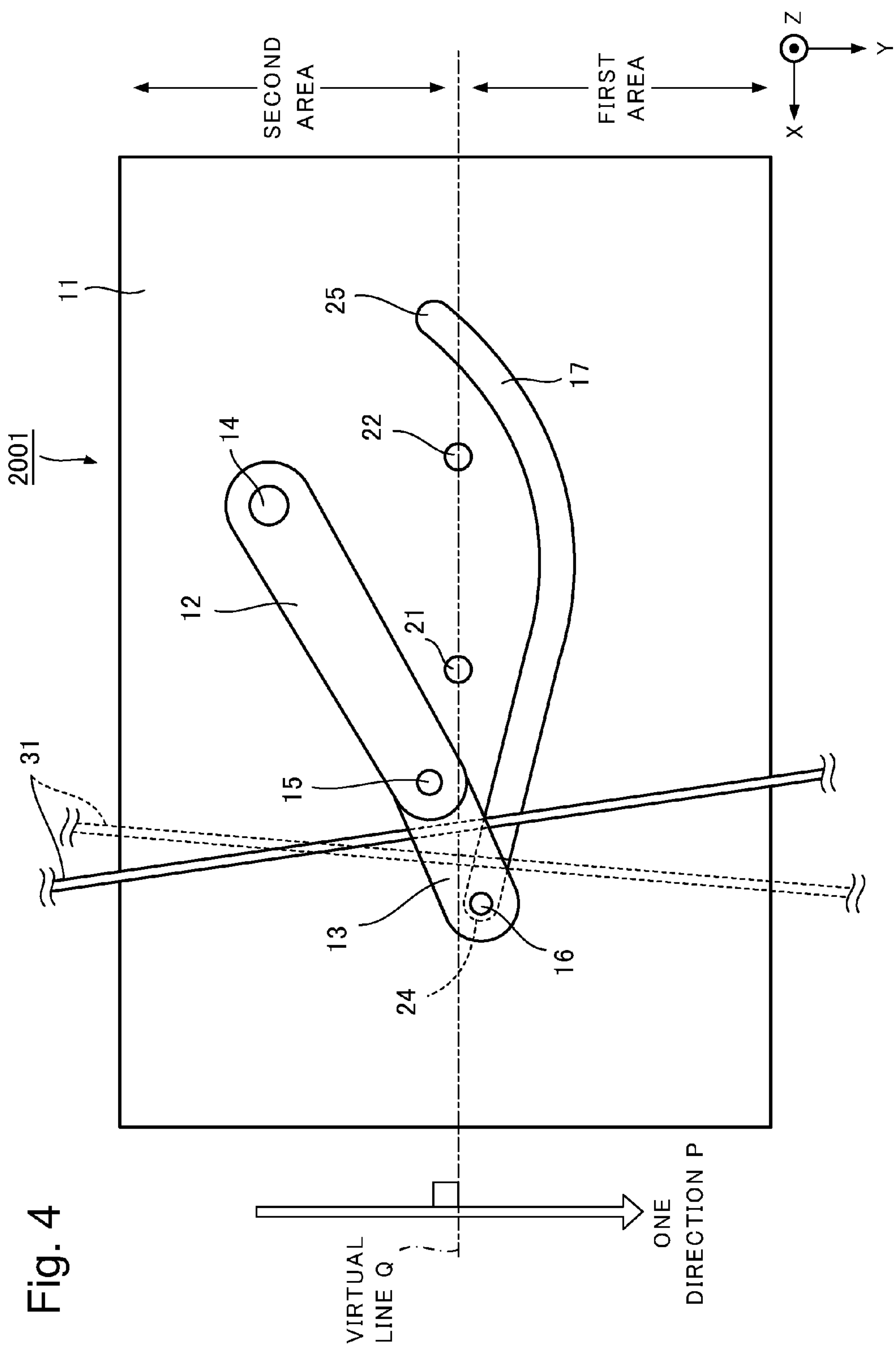


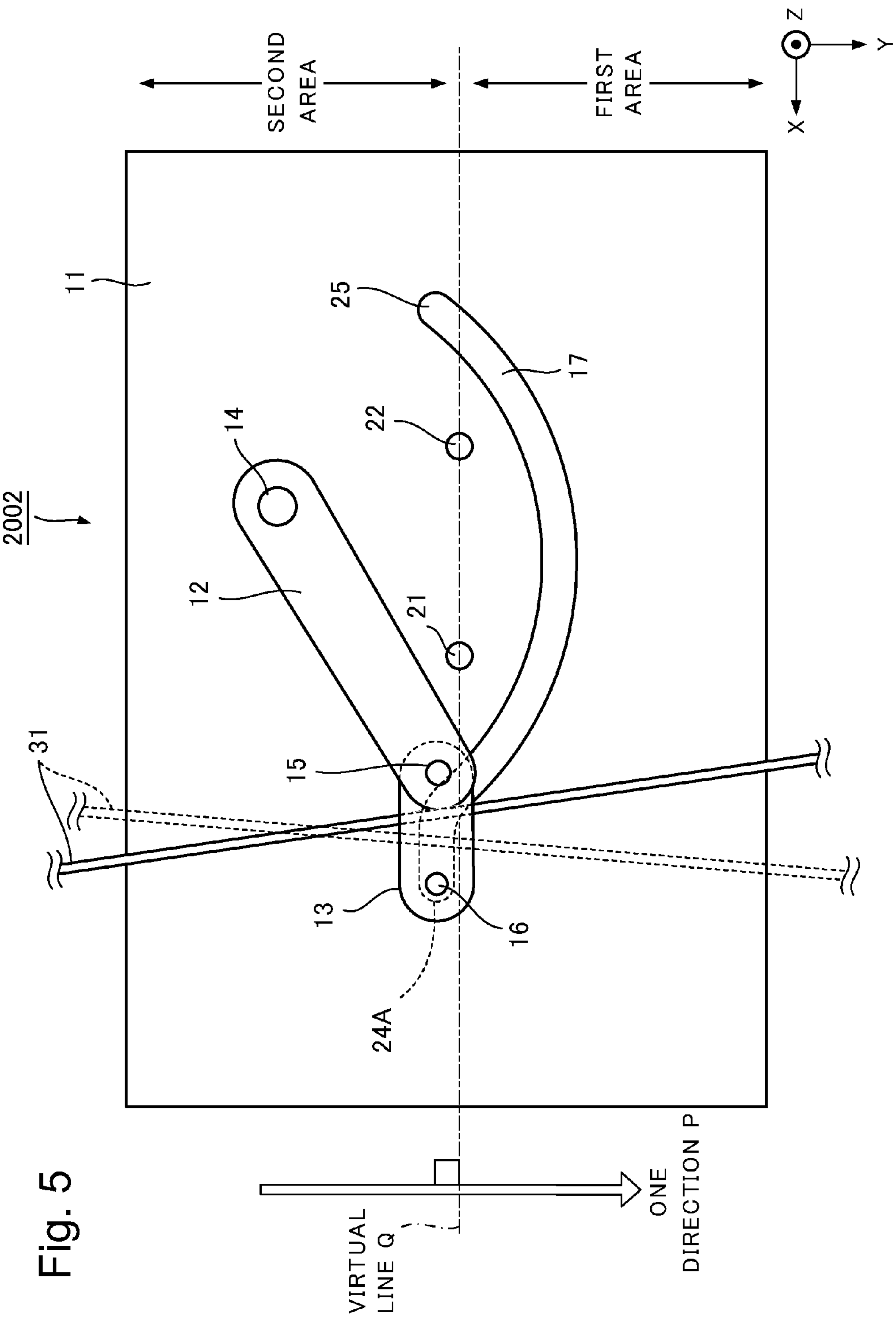
Fig. 3



SECOND AREA
FIRST AREA
Z
Y
X
11
2001
25
17
22
14
12
21
31
15
13
16
24
VIRTUAL LINE Q
ONE DIRECTION P

Fig. 4

Fig. 5


2002
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FIRST AREA
Z
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16
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21
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24A
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31
VIRTUAL LINE Q
ONE DIRECTION P

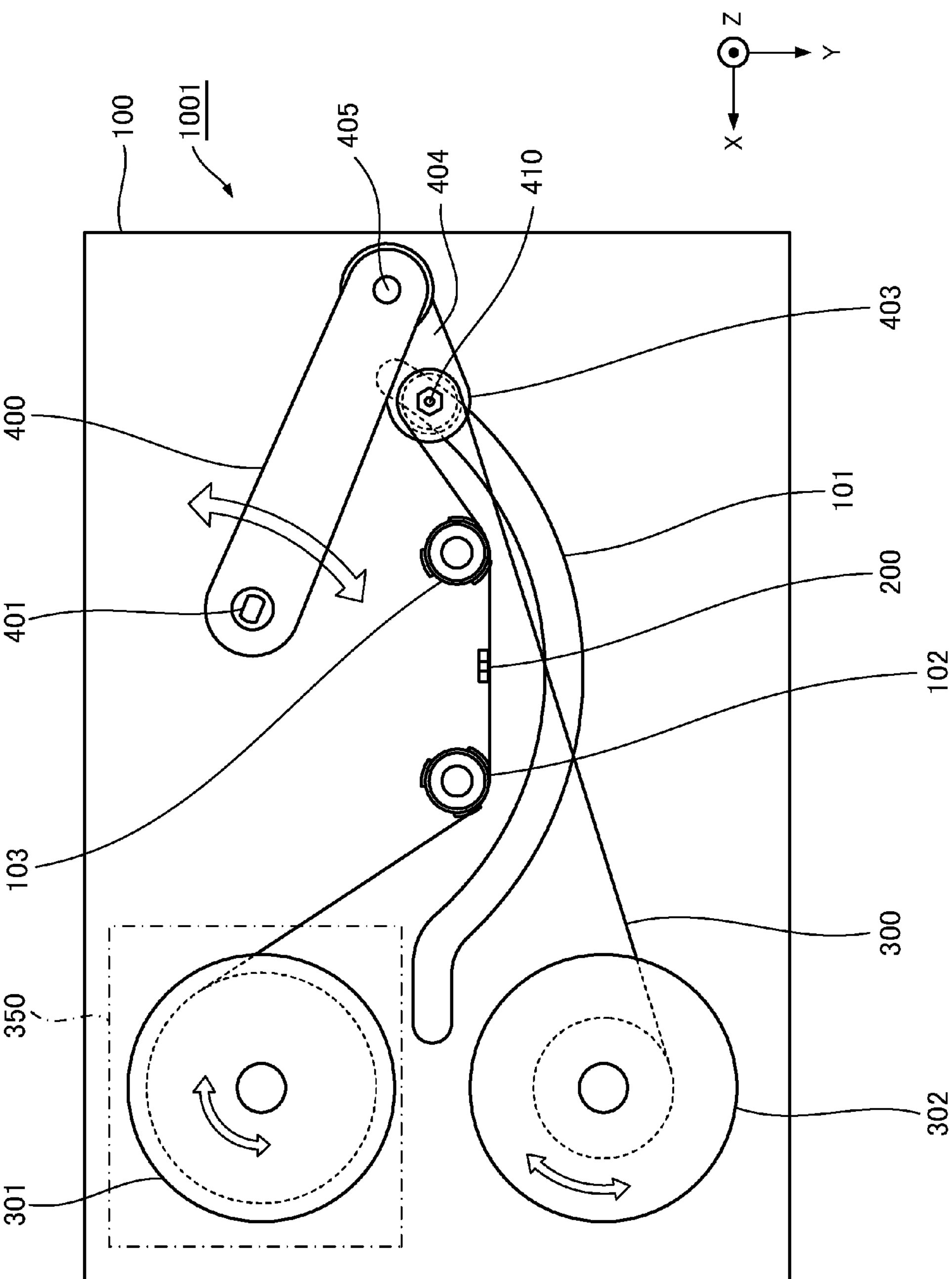
100
1001
405
404
410
403
400
401
101
200
102
103
300
350
301
302
Z
Y
X

Fig. 6

LINE-SHAPED MATERIAL CONVEYANCE MECHANISM, LINE-SHAPED MATERIAL CONVEYANCE METHOD, AND TAPE CONVEYANCE MECHANISM

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2013-197718, filed on Sep. 25, 2013, the disclosure of which is incorporated herein in its entirety by reference.

TECHNICAL FIELD

The present invention relates to a technical field of conveying a line-shaped material such as a magnetic tape, for example.

BACKGROUND ART

Recently, as a magnetic tape conveyance apparatus is miniaturized and made higher in density, a mechanism of conveying a magnetic tape to a magnetic head has become more complex. Consequently, the magnetic tape conveyance apparatus has a problem of taking much time to convey the magnetic tape. To achieve a higher density of data recorded in the magnetic tape, a magnetic material applied on the magnetic tape has been improved and changed. The conveyance apparatus is preferably configured so that the magnetic tape can be abutted on the magnetic head by contact friction appropriate for the magnetic material applied on the magnetic tape.

Patent Literature 1 (Japanese Laid-open Patent Publication No. 63-79263) discloses a magnetic tape conveyance method. In an apparatus disclosed in the Patent Literature 1, to set a state where a magnetic head can read or write a magnetic tape, a reader block of a magnetic tape cartridge is conveyed to a machine reel by a sub-arm. In the apparatus, the magnetic tape stretched between the magnetic tape cartridge and the machine reel is guided to a disposing position of the magnetic head by a main tension arm.

Patent Literature 2 (Japanese Utility Model Registration No. 3137776) discloses a magnetic tape apparatus that can perform a sure loading or unloading operation of a magnetic tape. In the apparatus disclosed in the Patent Literature 2, the magnetic tape connected between a supply reel and a take-up reel is conveyed to a position of a magnetic head by two movable guide rollers.

However, in the magnetic tape conveyance method disclosed in the Patent Literature 1, the mechanism of conveying the magnetic tape to the position where the magnetic tape can be read or written by the magnetic head is achieved by the sub-arm and the main tension arm. In the conveyance mechanism disclosed in the Patent Literature 1, arm movement goes through two steps. In other words, in the conveyance mechanism, places (areas) where the two steps can be performed are necessary due to unvariable moving distances of two types of arms. Tension of the magnetic tape is not able to be maintained so well that the magnetic tape may be cut.

Further, in the magnetic tape apparatus disclosed in the Patent Literature 2, the two movable guide rollers are necessary, and a mechanism of simultaneously operating the two guide rollers by one motive force is necessary. As a result, the number of components for the tape conveyance apparatus itself increases, thus creating a problem of a complex structure.

SUMMARY

A main object of the present invention is to provide a technology for conveying a line-shaped material to a desired position in a compact area through one step.

One aspect of the present invention of a line-shaped material conveyance mechanism includes;

first and second support members arranged on a virtual line perpendicular to one direction in a substrate parallel to the one direction, perpendicularly to the one direction and the virtual line;

a guide groove disposed, in case that the substrate is divided into two areas with the virtual line set as a reference, over a first area to a second area, in the substrate through a side of the first area side of the first and second support members;

a first rotary arm having one end pivotally supported by a first rotary shaft disposed in the second area and rotatable around the first rotary shaft; and

a second rotary arm having one end rotatably connected to the other end of the first rotary arm by a second rotary shaft and including a third support member at the other end, wherein

one end of the guide groove on the second support member side is disposed in the second area side, and

the third support member is movable along the guide groove from the other end of the guide groove located in the first support member side to the one end located in the second support member side by rotating the first rotary arm around the first rotary shaft, and movable along the guide groove to the other end by reversely rotating the first rotary arm.

One aspect of the present invention of a tape conveyance mechanism includes;

a line-shaped material conveyance mechanism in the present invention, the line-shaped material being a magnetic tape; and

a magnetic head arranged between a first support member and a second support member of the line-shaped material conveyance mechanism to perform reading from or writing to the magnetic tape.

One aspect of the present invention of a line-shaped material conveyance method includes;

arranging first and second support members on a virtual line perpendicular to one direction in a substrate parallel to the one direction perpendicularly to the one direction and the virtual line;

disposing a guide groove, in case that the substrate is divided into two areas with the virtual line set as a reference, over a first area to a second area, in the substrate through a side of the first area side of the first and second support members;

arranging a first rotary arm having one end pivotally supported by a first rotary shaft disposed in the second area and rotatable around the first rotary shaft, and a second rotary arm having one end rotatably connected to the other end of the first rotary arm by a second rotary shaft and including a third support member at the other end;

disposing one end of the guide groove on the second support member side in the second area side, thus enabling the third support member to move along the guide groove from the other end of the guide groove located in the first support member side to the one end located in the second support member side by rotating the first rotary arm around the first rotary shaft, and move along the guide groove to the other end by reversely rotating the first rotary arm; and

conveying, when the third support member is located at the other end, a flexible line-shaped material disposed along a side between the third support member and the first support member to the one end on the second support member side or a vicinity thereof in a hooked state by the third support member in response to the rotation of the first rotary arm.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary features and advantages of the present invention will become apparent from the following detailed description when taken with the accompanying drawings in which:

FIG. **1** is a perspective view illustrating a structure of a tape conveyance mechanism **1001** according to a first exemplary embodiment of the present invention;

FIG. **2** is a top view illustrating the tape conveyance mechanism (in a state before tape conveyance) illustrated in FIG. **1** when seen from a Z-axis direction;

FIG. **3** is a diagram illustrating an aspect where the tape conveyance mechanism illustrated in FIG. **1** has guided a tape to a sensor position;

FIG. **4** is a top view illustrating a structure of a line-shaped material conveyance mechanism **2001** according to a second exemplary embodiment of the present invention;

FIG. **5** is a top view illustrating a structure of a line-shaped material conveyance mechanism **2002** according to a third exemplary embodiment of the present invention; and

FIG. **6** is a diagram describing another exemplary embodiment of the present invention.

EXEMPLARY EMBODIMENT

Hereinafter, the exemplary embodiments of the present invention will be described with reference to the accompanying drawings. In each exemplary embodiment described below, for easier description, it is assumed that a conveyance mechanism (conveyance structure and conveyance apparatus) according to the each exemplary embodiment is disposed in a three-dimensional space including X, Y, and Z axes.

First Exemplary Embodiment

FIG. **1** is a perspective view illustrating a structure of a tape conveyance mechanism **1001** according to a first exemplary embodiment of the present invention. FIG. **2** is a top view illustrating the tape conveyance mechanism **1001** illustrated in FIG. **1** when seen from a Z-axis direction, specifically a state before tape conveyance. In FIG. **2**, a pedestal **402** illustrated in FIG. **1** is omitted.

The tape conveyance mechanism **1001** illustrated in FIG. **1** is one example where all mechanisms are arranged on a substrate **100**. These mechanisms may be arranged at a plurality of members in a dispersed manner instead of an integrated structure illustrated in FIG. **1** or the like as long as the mechanisms can be arranged such as illustrated in FIG. **1** or the like (similar in the respective exemplary embodiments described below).

On the substrate **100**, a reel **301** is pivotally supported to be rotatable around a reel rotary shaft **406**. A reel **302** is pivotally supported to be rotatable around a reel rotary shaft **407**. A magnetic tape **300** is wound as an example of a flexible line-shaped material on the reel **301** and the reel **302** to serve as a cross-link (lateral bridge) between the reel **301** and the reel **302**. The reel **301** and the reel **302** are arranged to sandwich one end of a guide groove **101** and spaced from each other to prevent interference with each other's rotational operation.

On the substrate **100**, there are arranged a guide roller **102** serving as a first support member, a magnetic head **200** serving as a sensor, and a guide roller **103** serving as a second support member on a virtual line perpendicularly intersecting a virtual straight line connecting a center point (reel rotary shaft **406**) of the reel **301** with a center point (reel rotary shaft **407**) of the reel **302**. The magnetic head **200** is located between the guide roller **102** and the guide roller **103**. A rotary shaft of the guide roller **102** and a rotary shaft of the guide roller **103** are vertically arranged on the substrate **100**.

The magnetic head **200** is movable in at least ±Z directions (directions perpendicular to the substrate **100**) by a mechanism not illustrated. Accordingly, during conveyance of the magnetic tape **300** in ±X directions by the guide roller **102** and the guide roller **103**, the magnetic tape **300** can slide (perform tracking) at a predetermined position, unobstructed by the magnetic head **200**. As such a mechanism, a general mechanism can be employed at present. Thus, in the first exemplary embodiment, detailed description of the mechanism will be omitted.

On the substrate **100**, the guide groove **101** is disposed to pass through sides of the guide roller **102**, the magnetic head **200**, and the guide roller **103**. A feature of the guide groove **101** will be described below.

On the substrate **100**, as illustrated in FIG. **1**, the pedestal **402** is disposed in parallel with the substrate **100**. In the first exemplary embodiment, the guide roller **102**, the magnetic head **200**, and the guide roller **103** are arranged between the substrate **100** and the pedestal **402**.

A first rotary arm **400** has one end pivotally supported by a rotary shaft **401** that is a first rotary shaft, and is configured to be rotatable around the first rotary shaft. The rotary shaft **401** may be fixed to the pedestal **402** or the substrate **100**.

A virtual straight line A (not illustrated) parallel to the virtual straight line connecting the reel **301** with the reel **302** and passing through the guide roller **102** is assumed. Furthermore, a virtual straight line B (not illustrated) parallel to the virtual straight line connecting the reel **301** with the reel **302** and passing through the guide roller **103** is assumed.

The rotary shaft **401** is located in a −Y direction of the guide roller **102**, the magnetic head **200**, and the guide roller **103** and between the virtual straight line A and the virtual straight line B.

One end of a second rotary arm **404** is rotatably connected to the other end of the first rotary arm **400** by a rotary shaft **405** that is a second rotary shaft. A movable guide roller **403** that is a third support member is disposed at the other end of the second rotary arm **404**. The movable guide roller **403** is rotatable around a roller rotary shaft **410**.

The other end of the second rotary arm **404** is a free end. Accordingly, the roller rotary shaft **410** is movable along the guide groove **101**. The rotary shaft **405** is not fixed to the substrate **100**. Accordingly, the rotary shaft **405** is movable to draw a locus parallel to the X axis (substrate **100**) in a space above the substrate **100** according to motions of the first rotary arm **400** and the second rotary arm **404**. A moving direction of the roller rotary shaft **410** is regulated by the guide groove **101**, and thus a locus drawn by the roller rotary shaft **410** is also regulated according to the motions of the first rotary arm **400** and the second rotary arm **404**.

In the tape conveyance mechanism **1001** according to the first exemplary embodiment, when the roller rotary shaft **410** (movable guide roller **403**) is located at an end on each side of the reels **301** and **302**, the magnetic tape **300** is laid between the roller rotary shaft **410** and the guide roller **102** (FIGS. **1** and **2**). The tape conveyance mechanism **1001** can set the magnetic tape **300** in a state illustrated in FIG. **3** described below from this state.

FIG. **3** is a top view illustrating the tape conveyance mechanism **1001** illustrated in FIG. **1** when seen from the Z-axis direction, specifically a state after the tape conveyance. In other words, the state illustrated in FIG. **3** is a state where the first rotary arm **400** has rotated around the rotary shaft **401** to move the roller rotary arm **410** (movable guide roller **403**) from one end side (refer to FIG. **2**) of the guide groove **101** to the other end side. In the tape conveyance mechanism **1001**, the first rotary arm **400** rotates to hook the magnetic tape **300** serving as the lateral bridge between the reels **301** and **302** on the roller rotary shaft **410** (movable guide roller **403**) while the roller rotary arm **410** moves from one end side (refer to FIG. **2**) of the guide groove **101** to the other end side. Further, by moving to the other side of the guide groove **101** through the rotation of the first rotary arm **400**, the roller rotary shaft **410** (movable guide roller **403**) can convey the magnetic tape **300** to one end of the guide roller **103** side or the vicinity thereof. By this operation, a part of the magnetic tape **300** comes into contact with the magnetic head **200** between the guide roller **102** and the guide roller **103**. The magnetic tape **300** is conveyed according to rotation of at least one of the reel **301** and the reel **302** to slide on a surface of the magnetic head **200** in a +X direction or a −X direction.

Further, in a state where the roller rotary shaft **410** (movable guide roller **403**) is located on the other end side of the guide groove **101**, the first rotary arm **400** is rotatable clockwise or anticlockwise around the rotary shaft **401**. Through the rotation of the first rotary arm **400**, the first rotary arm **400** and the second rotary arm **404** rotate relatively to each other around the rotary shaft **405**, and an angle formed between the first rotary arm **400** and the second rotary arm **404** changes. Thus, the tape conveyance mechanism **1001** can control the magnetic tape **300** slidable to the magnetic head **200** between the guide roller **102** and the guide roller **103** to desired tension. Various technologies have been offered concerning a mechanism for rotating (driving) the first rotary arm **400** clockwise or anticlockwise around the rotary shaft **401** and a technology for controlling an operation of the tape conveyance mechanism **1001** according to the measured tension of the magnetic tape **300**. In the first exemplary embodiment, any one of the technologies (mechanisms) can be employed, and detailed description thereof will be omitted (similar in the respective exemplary embodiments described below).

To achieve the aforementioned series of operations, in the first exemplary embodiment, the rotary shaft **401** is disposed at a position satisfying, for example, conditions described below.

A virtual straight line parallel to the virtual straight line connecting the reel **301** with the reel **302** and passing through the guide roller **102** is set as a virtual straight line A (not illustrated). Further, a virtual straight line parallel to the virtual straight line connecting the reel **301** with the reel **302** and passing through the guide roller **103** is set as a virtual straight line B (not illustrated). Further, a length (first distance) from the rotary shaft **401** (first rotary shaft) to one end on each side of the reels **301** and **302** of the guide groove **101** is set as a length L1. A length (second distance) obtained by adding together a distance from the rotary shaft **401** of the first rotary arm **400** to the rotary shaft **405** (second rotary shaft) and a distance from the rotary shaft **405** of the second rotary arm **404** to the roller rotary shaft **410** (third support member) is set as a length L2. A length (third distance) from the rotary shaft **401** (first rotary shaft) to one end on the guide roller **103** side of the guide groove **101** is set as a length L3.

As a first condition, as described above, the rotary shaft **401** is located in the area in the −Y direction of the guide roller **102**, the magnetic head **200**, and the guide roller **103** (second area side illustrated in FIGS. **4** and **5** described below) and between the virtual straight line A and the virtual straight line B. A length from the rotary shaft **401** of the first rotary arm **400** to the rotary shaft **405** (second rotary shaft) is set as a length L4.

As a second condition, in the first exemplary embodiment, the length L1 (first distance) is equal to or shorter than the length L2 (second distance). In a case that the length L1 is shorter than the length L2, as illustrated in FIG. **2**, the first rotary arm **400** and the second rotary arm **404** take a convexed form in a lower side (first area side illustrated in FIGS. **4** and **5** described below).

As a third condition, in the first exemplary embodiment, the length L3 (third distance) is shorter than the length L4.

The tape conveyance mechanism **1001** according to the first exemplary embodiment can convey the magnetic tape **300** to a desired position in a compact area (occupied area) through one step. It is because of a structure where the first rotary arm **400** and the second rotary arm **404** are rotatably connected to each other by the rotary shaft **405**. Accordingly, an operation range from conveyance of the magnetic tape **300** to the magnetic head **200** to permission of reading or writing with respect to the magnetic tape **300** by the magnetic head **200** can be reduced compared with that in the Patent Literature described above. Moreover, the tape conveyance mechanism **1001** can continuously complete the operation of conveying the magnetic tape **300** to the magnetic head **200** and enabling the magnetic head **200** to perform reading or writing with respect to the magnetic tape **300** through one step instead of the two steps in the Patent Literature described above.

The tape conveyance mechanism **1001** can maintain the tension of the magnetic tape **300** in an appropriate condition by controlling the rotational operation of the first rotary arm **400** in a state illustrated in FIG. **3**. Thus, the tape conveyance mechanism **1001** can obtain an effect of being able to prevent the magnetic tape **300** from being cut by tension.

Second Exemplary Embodiment

FIG. **4** is a top view illustrating a structure of a line-shaped material conveyance mechanism **2001** according to a second exemplary embodiment of the present invention. The line-shaped material conveyance mechanism **2001** according to the second exemplary embodiment is disposed on the substrate **11**.

In the second exemplary embodiment, a virtual line Q perpendicular to one direction P set as a reference is assumed on a substrate surface of a substrate **11**. On the substrate **11**, a first support member **21** and a second support member **22** are arranged at positions through which the virtual line Q passes perpendicularly to the reference surface.

In the second exemplary embodiment, for easier description, the substrate **11** is virtually divided into a first area and a second area with the virtual line Q set as a reference as illustrated in FIG. **4**.

A guide groove **17** is disposed, over the first area to the second area, in the substrate **11** through the side of the first area side of the first support member **21** and the second support member **22**.

A first rotary arm **12** is pivotally supported by a first rotary shaft **14** having one end disposed in the second area, to be rotatable around the first rotary shaft **14**.

A second rotary arm **13** has one end rotatably connected to the other end of a first rotary arm **12** by a second rotary shaft **15**, and includes a third support member **16** at the other end.

As illustrated in FIG. **4**, in the line-shaped material conveyance mechanism **2001**, one end **25** of the guide groove **17** on the second support member **22** side is disposed in the second area side. One end **24** of the guide groove **17** on the first support member **21** side is disposed in the first area side.

The third support member **16** is guided along the guide groove **17** to be movable in response to rotation of the first rotary arm **12** and the second rotary arm **13** around the first rotary shaft **14**.

In the line-shaped material conveyance mechanism **2001** having the aforementioned structure, the third support member **16** can hook a flexible linear member **31** disposed along the side between the third support member **16** and the first support member **21** during the movement from one end **24** of the guide groove **17** to the other end **25**. The third support member **16** can convey the linear member **31** to the second end **25** on the second support member side **22** or the vicinity thereof by moving more toward the other end **25** of the guide groove **17**.

When the third support member **16** is located near the second end **25** of the guide groove **17**, an intensity of a tensile force (tension) of the line-shaped material **31** by the third support member **16** can be varied by appropriately controlling a rotational direction of the first rotary arm **12**. Accordingly, the line-shaped material conveyance mechanism **2001** can control (adjust) the tension of the line-shaped material **31** disposed along the side between the first support member **21** and the second support member **22** in an appropriate condition.

In other words, the line-shaped material conveyance mechanism **2001** can convey the line-shaped material **31** to a desired position in a compact area (occupied area) through one step. It is because of a structure where the first rotary arm **12** and the second rotary arm **13** are rotatably connected to each other by the rotary shaft **15**. This structure makes it possible to reduce an operation range until a state where the line-shaped material **31** disposes along the side between the first support member **21** and the second support member **22** with the appropriate tensile force (tension) compared with that in the Patent Literature described above. The structure enables the operation until the state where the line-shaped material **31** disposes along the side between the first support member **21** and the second support member **22** with the appropriate tensile force (tension) to be continuously completed through one step instead of the two steps in the Patent Literature described above.

Third Exemplary Embodiment

Next, a configuration of a line-shaped material conveyance mechanism **2002** according to a third exemplary embodiment of the present invention will be described referring to FIG. **5**. FIG. **5** is a top view illustrating a structure of the line-shaped material conveyance mechanism **2002** according to the third exemplary embodiment. Components of the line-shaped material conveyance mechanism **2002** same as or similar to those of the line-shaped material conveyance mechanism **2001** according to the second exemplary embodiment are denoted by the same reference numerals illustrated in FIG. **4**, and repeated description will be omitted.

In the second exemplary embodiment, as illustrated in FIG. **4**, one end **24** of the guide groove **17** on the first support member **21** side is located in the first area. On the other hand, in the line-shaped material conveyance mechanism **2002** according to the third exemplary embodiment, as illustrated in FIG. **5**, one end **24**A of the guide groove **17** on the first support member **21** side is located in the second area. A part of the guide groove **17** located in the second area is disposed along the virtual line Q. Accordingly, the third support member **16** can move in parallel with or roughly in parallel with the virtual line Q during movement from one end **24**A of the guide groove **17** to the other end (second end **25**).

The line-shaped material conveyance mechanism **2002** according to the third exemplary embodiment can obtain the following effects in addition to the same effects as those of the second exemplary embodiment.

In other words, one end **24**A of the guide groove **17** on the first support member **21** side is located in the second area. Accordingly, the line-shaped material conveyance mechanism **2002** can control (adjust) tension of the line-shaped material **31** between the first support member **21** and the second support member **22** more surely, compared with the second exemplary embodiment.

A shape of a part near one end **24**A of the guide groove **17** is formed in parallel with or roughly in parallel with the virtual line Q, and thus the line-shaped material conveyance mechanism **2002** can obtain the following effects. In other words, for example, even when a plurality of reels are disposed in one direction P as in the case of the first exemplary embodiment, the line-shaped material conveyance mechanism **2002** can achieve narrowing of a space between the reels and sure conveyance of the line-shaped material **31** by the third support member **16**. In other words, in the configuration of the third exemplary embodiment, a curved part of the guide groove **17** disposed to detour around the first support member **21** and the second support member **22** can be located closer to a space between the first support member **21** and the second support member **22** compared with the guide groove **17** of the second exemplary embodiment. Thus, an occupied area (substrate **11**) of the line-shaped material conveyance mechanism **2002** can be reduced compared with the second exemplary embodiment.

Other Exemplary Embodiments

The present invention is not limited to the first to third exemplary embodiments. Various embodiments can be employed. For example, the first exemplary embodiment assumes a two-reel type magnetic tape cartridge (in other words, type including two reels **301** and **302** for taking up tape in cartridge). Instead, the present invention can be applied to a one-reel type magnetic tape cartridge (in other words, type including one reel for taking up tape in cartridge). For example, as an embodiment in a case that the present invention is applied to the one-reel type magnetic tape cartridge, a configuration illustrated in FIG. **6** may be cited. The configuration illustrated in FIG. **6** is a modified example of the first exemplary embodiment. In description below referring to FIG. **6**, names same as those of the first exemplary embodiment are denoted by the same reference numerals, and repeated description of common portions will be omitted.

In the configuration illustrated in FIG. **6**, one of reels **301** and **302** (reel **301** in this case) is a reel in a cartridge **350**, while the other (reel **302**) functions as a take-up reel (machine reel).

In the configuration illustrated in FIG. **6**, the magnetic tape **300** pulled out from the reel **301** in the cartridge **350** by, for example, an arm (not illustrated) or the like is guided to the take-up reel **302** to be set as a lateral bridge between the reels **301** and **302**. In this state, as in the case of the first exemplary embodiment, the magnetic tape **300** is conveyed to a position where the tape can be read by the magnetic head **200**. Similarly, in the configuration illustrated in FIG. **6**, effects similar to those of the first exemplary embodiment can be obtained.

The previous description of exemplary embodiments is provided to enable a person skilled in the art to make and use the present invention. Moreover, various modifications to these exemplary embodiments will be readily apparent to those skilled in the art, and the generic principles and specific examples defined herein may be applied to other exemplary embodiments without the use of inventive faculty. Therefore, the present invention is not intended to be limited to the exemplary embodiments described herein but is to be accorded the widest scope as defined by the limitations of the claims and equivalents.

Further, it is noted that the inventor's intent is to retain all equivalents of the claimed invention even if the claims are amended during prosecution.

The invention claimed is:

1. A line-shaped material conveyance mechanism comprising:

a first support member standing on a substrate;

a second support member standing on the substrate spaced from the first support member,

wherein a virtual line extends across the first and second support members, and wherein a portion of a line-shaped material is stretched between reels across an extension of the virtual line beyond the first support member;

a first rotary arm with one end attached to a first rotary shaft standing at a fixed position on the substrate so that a second end of the first rotary arm moves across a surface of the substrate;

a second rotary arm with one end attached to a second rotary shaft connected to the second end of the first rotary arm so that a second end of the second rotary arm moves across the surface of the substrate;

a guide groove in the substrate, the guide groove having ends that are beyond the first and second support members and that are on a same one side of the virtual line, the guide groove crossing the virtual line so that between the first and second support members the guide groove is on a second side of the virtual line opposite the one side;

a third support member attached to the second end of the second rotary arm and that moves along the guide groove;

wherein the first and second rotary arms are arranged to move so that, at one of the ends of the guide groove beyond the first support member, the third support member hooks the portion of the line-shaped material stretched across the virtual line and conveys the stretched portion to an opposite one of the ends of the guide groove.

2. The line-shaped material conveyance mechanism according to claim **1**, wherein a first distance from the first rotary shaft to the one of the ends of the guide groove is not greater than a second distance obtained by adding together a distance from the first rotary shaft to the second rotary shaft and a distance from the second rotary shaft to the third support member.

3. The line-shaped material conveyance mechanism according to claim **2**, wherein when the first distance is shorter than the second distance.

4. The line-shaped material conveyance mechanism according to claim **1**, wherein the first rotary shaft is pivotally supported between the first support member and the second support member on a side of the virtual line, between the first and second support members, opposite the guide groove.

5. The line-shaped material conveyance mechanism according to claim **1**, wherein the reels are arranged to sandwich the one of the ends of the guide groove, and

the third support member pulls the line-shaped material disposed between the reels toward the opposite one of the ends of the guide groove in response to rotation of the first rotary arm.

6. The line-shaped material conveyance mechanism according to claim **1**, wherein at least one of the first to third support members includes a rotary roller configured to convey the line-shaped material.

7. A tape conveyance mechanism comprising:

the line-shaped material conveyance mechanism according to claim **1**, the line-shaped material being a magnetic tape; and

a magnetic head arranged between a first support member and a second support member of the line-shaped material conveyance mechanism to perform reading from or writing to the magnetic tape.

8. The line-shaped material conveyance mechanism according to claim **1**, wherein the opposite one of the ends of the guide groove is on the one side of the virtual line beyond the second support member and spaced from the reels.

9. A line-shaped material conveyance method comprising:

standing a first support member on a substrate;

standing a second support member on the substrate spaced from the first support member;

extending a virtual line across the first and second support members;

stretching a portion of a line-shaped material between reels across an extension of the virtual line beyond the first support member;

attaching one end of a first rotary arm to a first rotary shaft standing at a fixed position on the substrate so that a second end of the first rotary arm moves across a surface of the substrate;

attaching one end of a second rotary arm to a second rotary shaft connected to the second end of the first rotary arm so that a second end of the second rotary arm moves across the surface of the substrate;

forming a guide groove in the substrate, the guide groove having ends that are beyond the first and second support members and that are on a same one side of the virtual line, the guide groove crossing the virtual line so that between the first and second support members the guide groove is on a second side of the virtual line opposite the one side;

attaching a third support member to the second end of the second rotary arm so that the third support member moves along the guide groove;

arranging the first and second rotary arms to move so that, at one of the ends of the guide groove beyond the first support member, the third support member hooks the portion of the line-shaped material stretched across the virtual line and conveys the stretched portion to an opposite one of the ends of the guide groove.

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